CLAIMS

What is claimed is:

1. A powder system for use in solid freeform fabrication, comprising:

at least one polymer having reactive properties and fusible properties, wherein the at least one polymer is selected to be reactive with a liquid binder and is fusible at a temperature above the melting point or glass transition temperature of the at least one polymer.

2. The powder system of claim 1, wherein the at least one polymer comprises a single polymer having at least one reactive portion and at least one fusible portion.

3. The powder system of claim 2, wherein the single polymer is poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid).

4. The powder system of claim 1, wherein the at least one polymer comprises at least one reactive polymer and at least one fusible polymer.

5. The powder system of claim 4, wherein the at least one reactive polymer is a cationic polyelectrolyte, a mixture of cationic and anionic polyelectrolytes, a polymer having an epoxy functionality, a polymer having a primary amino group, polyvinyl alcohol, or mixtures thereof.

6. The powder system of claim 4, wherein the at least one reactive polymer is polyacrylic acid.

7. The powder system of claim 4, wherein the at least one reactive polymer is present in the powder system from approximately 5% by weight to approximately 75% by weight.

8. The powder system of claim 4, wherein the at least one fusible polymer has a melting point or glass transition temperature ranging from approximately 50°C to approximately 250°C.

9. The powder system of claim 4, wherein the at least one fusible polymer is a thermoplastic polymer selected from the group consisting of an acrylate polymer or copolymer, a methacrylate polymer or copolymer, a copolymer of vinyl/vinylidene chloride, poly(styrene-co-butyl-acrylate), a polyester, a low melting polyolefin, a polyurethane, a polyether-ester elastomer, poly(vinyl acetate), an ethylene-vinyl acetate co-polymer, a vinyl ester polymer, a vinyl ester copolymer, and mixtures thereof.

10. The powder system of claim 4, wherein the at least one fusible polymer is present in the powder system from approximately 25% by weight to approximately 95% by weight.

11. The powder system of claim 1, wherein the at least one polymer has a particle size ranging from approximately 15 μm to approximately 50 μm.

12. A powder system for use in solid freeform fabrication, comprising: at least one polymer having either reactive properties or fusible properties, wherein the at least one polymer is selected to be reactive with a liquid binder or is selected to be fusible at a temperature above the melting point or glass transition temperature of the at least one polymer.

13. The powder system of claim 12, wherein the at least one polymer comprises a single polymer having at least one reactive portion or at least one fusible portion.

14. The powder system of claim 13, wherein the single polymer is poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid).

15. The powder system of claim 12, wherein the at least one polymer comprises at least one reactive polymer.

16. The powder system of claim 15, wherein the at least one reactive polymer is a cationic polyelectrolyte, a mixture of cationic and anionic polyelectrolytes, a polymer having an epoxy functionality, a polymer having a primary amino group, polyvinyl alcohol, or mixtures thereof.

17. The powder system of claim 15, wherein the at least one reactive polymer is polyacrylic acid.

18. The powder system of claim 15, wherein the at least one reactive polymer is present in the powder system from approximately 5% by weight to approximately 75% by weight.

19. The powder system of claim 12, wherein the at least one polymer comprises at least one fusible polymer.

20. The powder system of claim 19, wherein the at least one fusible polymer has a melting point or glass transition temperature ranging from approximately 50°C to approximately 250°C.

21. The powder system of claim 19, wherein the at least one fusible polymer is a thermoplastic polymer selected from the group consisting of an acrylate polymer or copolymer, a methacrylate polymer or copolymer, a copolymer of vinyl/vinylidene chloride, poly(styrene-co-butyl-acrylate), a polyester, a low melting polyolefin, a polyurethane, a polyether-ester elastomer, poly(vinyl acetate), an ethylene-vinyl acetate co-polymer, a vinyl ester polymer, a vinyl ester copolymer, and mixtures thereof.

22. The powder system of claim 19, wherein the at least one fusible polymer is present in the powder system from approximately 25% by weight to approximately 95% by weight.

23. The powder system of claim 12, wherein the at least one polymer has a particle size ranging from approximately 15 µm to approximately 50 µm.

24. A material system for use in solid freeform fabrication, comprising: a liquid binder and at least one polymer that reacts with the liquid binder and is fusible at a temperature above the melting point or glass transition temperature of the at least one polymer.

25. The material system of claim 24, wherein the at least one polymer comprises a single copolymer that reacts with the liquid binder and is fusible.

26. The material system of claim 25, wherein the single polymer is poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid).

27. The material system of claim 24, wherein the at least one polymer comprises at least one reactive polymer and at least one fusible polymer.

28. The material system of claim 27, wherein the at least one reactive polymer is a cationic polyelectrolyte, a mixture of cationic and anionic polyelectrolytes, a polymer having an epoxy functionality, a polymer having a primary amino group, polyvinyl alcohol, or mixtures thereof.

29. The material system of claim 27, wherein the at least one reactive polymer is polyacrylic acid.

30. The material system of claim 27, wherein the at least one fusible polymer has a melting point or glass transition temperature ranging from approximately 50°C to approximately 250°C.

31. The material system of claim 27, wherein the at least one fusible polymer is a thermoplastic polymer selected from the group consisting of an acrylate polymer or copolymer, a methacrylate polymer or copolymer, a copolymer of vinyl/vinylidene chloride, poly(styrene-co-butyl-acrylate), a polyester; a low melting polyolefin, a polyurethane, a polyether-ester elastomer, poly(vinyl acetate), an ethylene-vinyl acetate co-polymer, a vinyl ester polymer or copolymer, and mixtures thereof.

32. The material system of claim 24, wherein the at least one polymer has a particle size ranging from approximately 15 µm to approximately 50 µm.

33. The material system of claim 24, wherein the liquid binder is an aqueous-based solution that comprises boric acid, an anionic polyelectrolyte, an amine, a compound having at least two aldehyde functionalities, or mixtures thereof.

34 . A material system for use in solid freeform fabrication, comprising: a liquid binder and at least one polymer that either reacts with the liquid binder or is fusible at a temperature above the melting point or glass transition temperature of the at least one polymer.

35 . The material system of claim 34, wherein the at least one polymer comprises a single copolymer that reacts with the liquid binder.

36 . The material system of claim 35, wherein the single polymer is poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid).

37 . The material system of claim 34, wherein the at least one polymer comprises a single copolymer that is fusible.

38 . The material system of claim 3, wherein the single polymer is poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid).

39 . The material system of claim 34, wherein the at least one polymer comprises at least one reactive polymer.

40 . The material system of claim 39, wherein the at least one reactive polymer is a cationic polyelectrolyte, a mixture of cationic and anionic polyelectrolytes, a polymer having an epoxy functionality, a polymer having a primary amino group, polyvinyl alcohol, or mixtures thereof.

41 . The material system of claim 39, wherein the at least one reactive polymer is polyacrylic acid.

42 . The material system of claim 34, wherein the at least one polymer comprises at least one fusible polymer.

43 . The material system of claim 42, wherein the at least one fusible polymer has a melting point or glass transition temperature ranging from approximately 50°C to approximately 250°C.

44 . The material system of claim 42, wherein the at least one fusible polymer is a thermoplastic polymer selected from the group consisting of an acrylate polymer or copolymer, a methacrylate polymer or copolymer, a copolymer of vinyl/vinylidene chloride, poly(styrene-co-butyl-acrylate), a polyester; a low melting polyolefin, a polyurethane, a polyether-ester elastomer, poly(vinyl acetate), an ethylene-vinyl acetate co-polymer, a vinyl ester polymer or copolymer, and mixtures thereof.

45 . The material system of claim 34, wherein the at least one polymer has a particle size ranging from approximately 15 μm to approximately 50 μm.

46. The material system of claim 34, wherein the liquid binder is an aqueous-based solution that comprises boric acid, an anionic polyelectrolyte, an amine, a compound having at least two aldehyde functionalities, or mixtures thereof.

47. A method of forming an object by solid freeform fabrication, comprising:

applying a powder system comprising at least one polymer having reactive properties and fusible properties to a flat surface;

applying a liquid binder to the powder system to form a solid layer; and fusing the solid layer.

48. The method of claim 47, wherein applying a powder system comprising at least one polymer having reactive properties and fusible properties to a flat surface comprises applying at least one polymer

having a particle size ranging from approximately 15 μm to approximately 50 μm.

49. The method of claim 47, wherein applying a powder system comprising at least one polymer having reactive properties and fusible properties to a flat surface comprises applying a single polymer having at least one reactive portion and at least one fusible portion to the flat surface.

50. The method of claim 49, wherein applying a single polymer having at least one reactive portion and at least one fusible portion to the flat surface comprises applying poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid) to the flat surface.

51. The method of claim 47, wherein applying a powder system comprising at least one polymer having reactive properties and fusible properties to a flat surface comprises applying at least one reactive polymer and at least one fusible polymer to the flat surface.

52. The method of claim 51, wherein applying at least one reactive polymer and at least one fusible polymer to the flat surface comprises applying a cationic polyelectrolyte, a mixture of cationic and anionic polyelectrolytes, a polymer having an epoxy functionality, a polymer having a primary amino group, polyvinyl alcohol, or mixtures thereof to the flat surface.

53. The method system of claim 51, wherein applying at least one reactive polymer and at least one fusible polymer to the flat surface comprises applying polyacrylic acid.

54. The method of claim 47, wherein applying a liquid binder to the powder system to form a solid layer comprises applying a liquid binder that reacts with the at least one polymer of the powder system.

55. The method of claim 47, wherein applying a liquid binder to the powder system to form a solid layer comprises activating the at least one polymer of the powder system with the liquid binder.

56. The method of claim 49, wherein applying a liquid binder to the powder system to form a solid layer comprises attaching the at least one reactive portion of the at least one polymer or the reactive polymers to one other.

57. The method of claim 47, wherein applying a liquid binder to the powder system to form a solid layer comprises applying an aqueous-based solution comprising boric acid, an anionic polyelectrolyte, an amine, a compound having at least two aldehyde functionalities, or mixtures thereof.

58. The method of claim 47, wherein fusing the solid layer comprises heating the solid layer to a temperature above a melting point or glass transition point of the at least one polymer.

59 . A method of forming an object by solid freeform fabrication, comprising:

applying a powder system comprising at least one polymer having either reactive properties or fusible properties to a flat surface;

applying a liquid binder to the powder system to form a solid layer; and fusing the solid layer.

60. The method of claim 59, wherein applying a powder system comprising at least one polymer having reactive properties to a flat surface comprises applying at least one polymer having a particle size ranging from approximately 15 µm to approximately 50 µm.

61 . The method of claim 59, wherein applying a powder system comprising at least one polymer having fusible properties to a flat surface comprises applying at least one polymer having a particle size ranging from approximately 15 µm to approximately 50 µm.

62 . The method of claim 59, wherein applying a powder system comprising at least one polymer having reactive properties to a flat surface comprises applying a single polymer having at least one reactive portion to the flat surface.

63 . The method of claim 62, wherein applying a single polymer having at least one reactive portion to the flat surface comprises applying poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid) to the flat surface.

64 . The method of claim 62, wherein applying a liquid binder to the powder system to form a solid layer comprises attaching the at least one reactive portion of the at least one polymer or the reactive polymers to one other.

65 . The method of claim 59, wherein applying a powder system comprising at least one polymer having fusible properties to a flat surface comprises applying a single polymer having at least one fusible portion to the flat surface.

66 . The method of claim 65, wherein applying a single polymer having at least one fusible portion to the flat surface comprises applying poly(ethylene-co-vinyl alcohol) or poly(ethylene co-methacrylic acid) to the flat surface.

67 . The method of claim 69, wherein applying a powder system comprising at least one polymer having reactive properties to a flat

surface comprises applying at least one reactive polymer to the flat surface.

68 . The method system of claim 67, wherein applying at least one reactive polymer to the flat surface comprises applying polyacrylic acid.

69 . The method of claim 67, wherein applying at least one reactive polymer to the flat surface comprises applying a cationic polyelectrolyte, a mixture of cationic and anionic polyelectrolytes, a polymer having an epoxy functionality, a polymer having a primary amino group, polyvinyl alcohol, or mixtures thereof to the flat surface.

70 . The method of claim 59, wherein applying a powder system comprising at least one polymer having fusible properties to a flat surface comprises applying at least one fusible polymer to the flat surface.
71 . The method of claim 70, wherein applying at least one fusible polymer to the flat surface comprises applying a cationic polyelectrolyte, a mixture of cationic and anionic polyelectrolytes, a polymer having an epoxy functionality, a polymer having a primary amino group, polyvinyl alcohol, or mixtures thereof to the flat surface.
72 . The method system of claim 70, wherein applying at least one fusible polymer to the flat surface comprises applying polyacrylic acid.

73 . The method of claim 59, wherein applying a powder system comprising at least one polymer having reactive properties to a flat surface comprises applying at least one reactive polymer to the flat surface.
74 . The method of claim 59, wherein applying a powder system comprising at least one polymer having fusible properties to a flat surface comprises applying at least one fusible polymer to the flat surface.

75 . The method of claim 59, wherein applying a liquid binder to the powder system to form a solid layer comprises applying a liquid binder that reacts with the at least one polymer of the powder system.

76 . The method of claim 59, wherein applying a liquid binder to the powder system to form a solid layer comprises activating the at least one polymer of the powder system with the liquid binder.

77 . The method of claim 59, wherein applying a liquid binder to the powder system to form a solid layer comprises applying an aqueous-based solution comprising boric acid, an anionic polyelectrolyte, an amine, a compound having at least two aldehyde functionalities, or mixtures thereof.

78. The method of claim 59, wherein fusing the solid layer comprises heating the solid layer to a temperature above a melting point or glass transition point of the at least one polymer.